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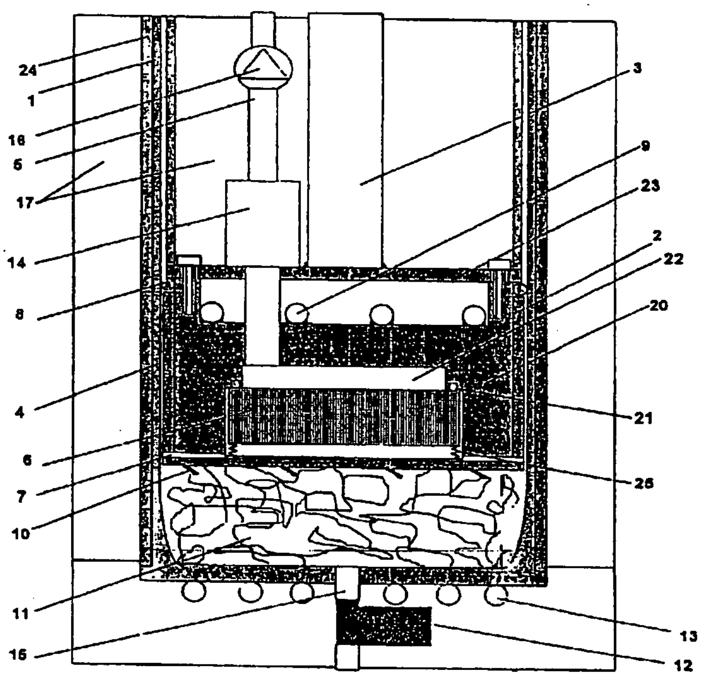
(54) **PROCEDE DE DESINFECTION THERMIQUE DE DECHETS NOTAMMENT A RISQUES BIOLOGIQUES ET DISPOSITIF DE MISE EN OEUVRE**

(54) **METHOD FOR THERMALLY DISINFECTING WASTE, PARTICULARLY BIOLOGICALLY HAZARDOUS WASTE, AND DEVICE THEREFOR**



(57) Procédé de désinfection thermique de déchets notamment à risques biologiques, caractérisé en ce que ces déchets sont placés dans une zone de compactage, puis soumis à une pression, les gaz émis par le compactage desdits déchets sont filtrés avant d'être évacués, puis le moule est étanchéifié et un chauffage est appliqué en contrôlant simultanément la température et la pression à l'intérieur du moule, la température dudit chauffage étant incluse entre 100 et 200 °C, toutes les pièces ayant été en contact avec les déchets étant également désinfectées et dispositif de mise en oeuvre de ce procédé.

(57) A method for thermally disinfecting waste, particularly biologically hazardous waste, wherein the waste is placed in a compaction area and compressed, and the gases given off during waste compaction are filtered before being discharged. The mould is then sealed and heated, and the temperature and pressure therein are monitored. The waste is heated to 100-200 °C and all parts that have contacted the waste are also disinfected. A device for carrying out the method is also disclosed.

ABSTRACT

A process for thermal disinfecting waste, particularly that with biological risks, featuring a compaction chamber in which the waste is subjected to pressure, the gasses given off by the compaction are filtered before being released, the chamber is then leak proofed and heat is applied, controlling simultaneously the temperature and the pressure inside the chamber, the temperature being maintained within a range of 100°c to 200°c, all parts having been in contact with the waste are also disinfected - and a device for the implementation of this process.

PROCESS FOR THERMAL DISINFECTION OF WASTE PARTICULARLY THAT WITH BIOLOGICAL RISKS AND DEVICE FOR IMPLEMENTING THIS PROCESS

This invention consists of a process for thermal disinfecting of waste particularly that with biological risks and a device for implementing this process.

The known medical disinfecting method from a technical point are as follows:

Wastes can be collected for treatment in a specialized area such as an incinerator or an installation for thermal treatment (overheated steam, high frequencies microwave, etc.). However, multiple manipulations (grinding, eventual sorting) are necessary as well as an intermediary storage for up to many days all of which cause an unacceptable proliferation of pathogenic germs and contamination risks all along the treatment chain (trash bin, grinder, vehicle used for transport, etc.);

The wastes can be treated in place in order to eliminate the proliferation problem during the intermediary storage. Machines using jets of ozone or of disinfectant solutions are currently being developed, but they cannot disinfect closed objects such as needles used to take blood samples, into which the disinfecting agents do not enter.

Other machines thermal this time, are beginning to be used but they require the grinding of wastes for a better thermal transfer of either overheated steam or a radio-frequency source for a more rapid heating. They are meant

for large treatment capacities (20 to 250 kg/hr) and they represent an important investment as they require a large space which frequently leads to placing them far from the waste generating site, which brings up again the problem of intermediate storage and the proliferation of germs.

The problem of small medical structures such as medical practitioners or small laboratories doing analyses, is not solved.

In fact, these small structures generate from 0.1 to 5 kg of wastes per day and are subjected to high fees for the transport and treatment of these wastes in an adequate installation.

In order to solve these inconveniences, one of the goals of the present invention is to propose a process for disinfecting wastes which can be used on the site where the wastes are being generated, which reduces contamination in a meaningful way and which can disinfect small quantities of wastes for an economical cost and a minimum congestion.

The process according to the invention is for the thermal disinfecting of wastes, particularly those with biological risks, featuring a compaction chamber in which the wastes are subjected to pressure, the gasses given off by the compaction are filtered before being released and the chamber is leak proofed and heat is applied controlling simultaneously the temperature and the pressure inside the chamber, the temperature being maintained within a range of 100°C to 200°C, all parts having been in contact with the

waste are also disinfected. The heat temperature is favorably kept above 134°C.

According to a preferred method of the invention, the wastes are covered beforehand with polymer, preferably composite, or placed in a polymer sack, preferably composite, before being brought into the compacting chamber. Preferably, the sack is made of composite polymer with a polypropylene or polyamide exterior covering and a polyethylene interior lining.

According to another preferred method of the invention, the process also includes the decompression of the compaction chamber, the cooling of the chamber and its compacted waste to a temperature below 60°C, its return to atmospheric pressure and the removal of the waste.

Another goal of the invention is to propose the implementation of this process by means of a device which includes a riser collar 1, a jack 2 operated piston 3, a compaction chamber 4, a filter 6, a thermal block 17, a sack 11 filled with waste to be disinfected, means of heating, means of leak proofing the device and a thermal insulation. Preferably, the heat is produced with electric heating elements and/or voltage-dependent resistors.

According to a preferred method of the invention, the device also includes a pressure transducer and/or a strain gauge 14, and/or an extractor 16 and/or an evacuation opening 15 coupled with a gate 12 with or without a frame.

Preferably, the face of the jack 2 which is in

contact with the wastes has lugs 10.

The piston 3 is hydraulically or mechanically operated or driven by an electric motor.

According to a preferred method of the invention, the leak proofing of the device is provided by O-ring seals or by suitably fitted inflatable rings strategically placed and/or with insulation gates 12 and 14.

Preferably, the jack 2, the compaction chamber 4 and the riser collar are completely or partially made of stainless metal of sufficient hardness not to be scratched or deteriorated during the compacting of needles and scalpels.

Preferably, the jack 2, the compaction chamber 4 and the riser collar 1 are totally or partially made of or covered with metal of high thermal conductivity.

On the other hand, the frame can be fitted with a thrust block 19.

According to a method unique to the invention, the filter 6 is placed in such a way that the temperature of this filter and of the space between it and the wastes is essentially the same as the temperature in the compaction area. The filter 6 is preferably of very high efficiency such as a mineral membrane and/or active carbon and/or teflon felt.

According to another method unique to the invention, the pressure transducer and/or the strain gauge are installed on the hydraulic system of the piston 3.

The following detailed description refers to the enclosed figures which illustrate (non restrictively) the invention:

Figures 1, 2 and 3 show sections of the invention's device.

Figure 1 shows sections of the device in position, ready to receive the waste sack;

Figure 2 shows sections of the device in a closed position during the treatment;

Figure 3 shows sections of the device in position for the evacuation of the compacted wastes;

Figure 4 shows detailed sections of the jack 2, the compaction chamber 4 and its riser collar 1 with which the wastes 11 are compacted and heated.

Figure 1 shows a device for implementing the process according to the invention, made up of a riser collar 1, a jack 2 equipped with a piston 3, a compaction chamber 4, a thermal block 17 and a sack 11 filled with wastes to be disinfected.

The sack 11 filled with wastes is placed in the compaction area. The material used for this sack is chosen according to the temperature of the treatment to be applied. Preferably, the sack is made of polymer, preferably composite, of high thickness. It is advantageous to use a sack made of composite polymer with a polypropylene or polyamide exterior and an interior lining of polyethylene.

The waste sack 11 is then placed in the compaction

chamber 4 when the jack 2 and its piston 3 are freed. The jack 2 and the piston 3 are then put into place above the compaction chamber either manually or using motorization (not shown). The piston 3, which can be either hydraulic or mechanical driven by an electric motor, can then lower the jack 2.

The jack 2 comprises a hollow metallic section which can be made of stainless metal to reduce the corrosion caused by usage conditions (hot and humid and under pressure with the possibility of certain acids being present). Preferably, the exterior of the jack is made of sufficiently hard metal not to be scratched or deteriorated during the compacting of stainless metal needles and scalpels.

According to a mode unique to the invention, the jack interior is filled or covered with a metal with a high thermal conductivity, such as aluminum. This special characteristic makes it possible to bring the jack 2, the filter 6 and the space between the waste sack 11, to the temperature in the compacting area in the most rapid and homogeneous way. Formation of temperature gradients is thus avoided as these would produce condensation on the cooler parts during the heating cycle. This condensation would be susceptible to dampen the filter 6 and thus damage it. The filter is thus disinfected during each treatment, limiting the risks of the accumulation of bacteriological or viral contamination. Preferably, the filter is not in contact with the waste. According to a unique method of the

invention, the filter 6 is directly in contact with the interior face of the jack.

According to yet another method of the invention, the compaction chamber 4 and the riser collar 1 are made of stainless metal to limit corrosion caused by conditions of use (hot, humid, hot and under pressure, with the possibility of certain acids being present), of sufficient hardness not to be scratched by needles or scalpels. Preferably, the riser collar 1 is made of conducting metal, since one of its functions, apart from guiding, is to bring heat to the upper part of the chamber. The riser collar is in contact with the upper part of the jack, near one or many resistances.

According to a method unique to the invention, during compaction, the air is evacuated toward the filter and the insulation gate 14 by means of holes 7. These holes are necessary for air passage but they also serve the function of letting go through the condensation that could form when the filter 6 and the gate 14 are in the jack 2, on its interior aluminum walls.

Preferably, the compaction chamber 4 and the jack 2, are equipped with heating elements with electrical resistances, eventually combined with a temperature regulator such as a thermostat. According to a preferred method of the invention, the interior jack wall which comes in contact with wastes is equipped with one or many resistances.

According to an advantageous variant of the invention, these resistances are voltage-dependent resistors with an electric conductivity such that they stop functioning when they reach the Curie temperature. They thus regulate themselves at a predetermined temperature in line with their composition. This allows the saving of a regulator and ensures that the temperature will not over rise following a malfunction of a regulator.

It is advantageous to use voltage-dependent resistors with a limit of 230°C, which, taking into account the contact thermal resistances, will ensure a stable temperature at their level of approximately 200°C (for waste treatment at 134°C it is possible to use voltage-dependent resistors regulating themselves at 180°C). It is to be noted that heating waste above 200°C is superfluous and could cause problems in the decomposition of certain plastics with toxic compounds (cyanures). Preferably, the heating temperature stands at between 100°C and 200°C, and offers better advantages at 134°C.

According to a unique method of the invention, the compaction chamber 4 is also equipped with a pressure transducer and/or a strain gauge (not shown). If the piston 3 is hydraulic, this pressure captor and/or strain gauge can be advantageously installed on the hydraulic system of the piston. This placement makes it possible to be aware of the hydraulic circuit pressure and thus the pressure put on the jack 2, by the vapor pressure following

the heating of wastes.

According to an advantageous method of the invention, if the piston 3 is mechanical and driven by an electric motor, a strain gauge is placed on the piston 3. This gauge will make it possible to know what pressure is placed on the said piston and it represents an alternative to the use of a pressure captor.

Preferably, the filter 6 is one of very high efficiency such as a mineral membrane and/or activated carbon and/or teflon felt. Preferably, the filter is made of teflon felt which permits a filtration at 0.2 um. This filter is set against the joint 21 with springs 25 to ensure leak proofing toward the exterior. The exterior face of the filter emerges in a plenum 22 attached to an insulation gate 14. This insulation gate is attached to a vent 5 and to a small extractor 16.

According to a preferred method of the invention, the grouping made up of the compaction chamber 4, the filter 6, the riser collar 1, the jack 2 and the gate 14 is thermally insulated and thus it is disinfected during each operation.

The use of a metallic sheath and of a thermal block may be necessary; for a disinfecting machine capable of treating waste masses of approximately 1 kg or a non-compacted volume of approximately 10 liters (0.1 density) will have for a diameter of approximately 160 mm for the chamber (and so as well, for the compacting jack) a

compaction chamber and a riser collar height of 500 mm. The flat bundle of compacted wastes will thus have a height of approximately 50 mm (density of compacted wastes next to 1). It would be very difficult and long to ensure heat distribution on such a height in a material such as stainless metal which is a poor heat conductor, even with a very good thermal block. An aluminum sheath and the installation of a good thermal block resolve this problem. Preferably, the metal sheathing is attached to the piston.

According to a method unique to the invention, the chamber and the piston are sufficiently adjusted to limit the extrusion of wastes in the slit. However, advantageously, a stainless metal rake with a diameter very slightly larger than that of the piston, is installed on the lower part of the piston, before the joint. This rake serves to avoid the extrusion toward the waste joint and thus protects the joint from destruction.

According to yet another method unique to the invention, the device is perfectly leak proof. This leak proofing is obtained through strategically placed seals and insulation gates 12 and 14. These seals can be O-ring or inflatable seals.

According to a unique method of the invention, an evacuation opening 15 in the insulation gate 12 permits, when necessary, the evacuation of the over abundant juices after disinfecting, or the treatment of liquid wastes.

During operation of the process of the invention,

the wastes are placed in a compaction area and put under pressure; the air in the waste sack 11 is sucked through the openings 7 and the filter 6 and is evacuated through the insulation gate 14, in an open position. The jack 2 goes down slowly if the seal 8 is an inflatable ring; exterior air is even sucked by the space between the chamber 4 and the jack 2, thus avoiding all contamination from spreading outside the machine. If the leak proofing is obtained by means of an O-ring seal, the leak proofing between the chamber 4 and the jack 2, is effective immediately when the seal is in contact with the chamber and the air present in the wastes can escape only by going through the filter. A pressure captor (not shown) ensures that the pressure obtained in the press does not reach unacceptable levels, which would result in an automatic opening of the insulation gate 14 or the opening of a valve on the hydraulic circuit of the piston 3, enabling it to rise.

When compaction is finished, if an inflatable ring is used for leak proofing 8, this ring is set in motion and the insulation gate 14 is closed to leak proof the treatment area where the compacted wastes are. The electrical resistances 9 and 13 are set in motion up to the pre-determined temperature. The temperature and the pressure inside the treatment area are simultaneously controlled by either a thermocouple or a platinum probe.

Preferably, the wastes are first covered with polymer, preferably composite, or placed in a polymer sack,

preferably composite, before being brought into the compaction area. A preferred method of the invention consists in using a polymer composite sack, the exterior of which is of polypropylene or polyamide and the interior of polyethylene.

The whole made up of the compaction chamber and the jack is thermally insulated; thermal losses are very small because of the 10 cm thick thermal block 17. As an example, for a machine capable of treating waste sacks of 1 to 2 kg, that is to say a compaction chamber of an interior diameter of 160 mm and a height of compacted wastes of approximately 50 mm, thermal losses are estimated at 250 w for a treatment temperature of 180°C.

The time required for the process according to the invention is variable and depends on the temperature to which the operator wished to bring the waste sack 11. For example, for a treatment at 130°C, the time required to bring the temperature up to it could be approximately one hour and the treatment time of approximately one hour. At 180°C, the temperature rise could take approximately two hours and the treatment time could be only a few minutes.

Heating is stopped when the required treatment time is reached. The compacted waste may be left in place until cooled, which, considering the good thermal insulation around the chamber and the jack, will require several hours, thus improving the treatment, or the compacted waste can be removed to treat another sack full of waste. In this case,

the insulation gate is opened gradually which helps to release the overheated water contained in the waste (blood, urine, etc...) and to release it as vapor. This release cools the flat bundle of compacted wastes faster.

The next step consists in cooling the compaction area down to a temperature below 60°C, to bring back this area to atmospheric pressure and to release the compacted waste sack. To do so the piston 3 is activated to raise the jack 2. For the unmoulding proper, according to a unique method of the invention, the device of the invention, has two additional characteristics:

the chamber 4 has a counter clearance;

the face of the jack 2 which is in contact with the compacted waste is equipped with lugs 10 which serve to hook the compacted waste to the jack 2 during its rise.

After complete release of the jack 2 and the mass of compacted waste, a small movement of the mass from the jack caused by the thrust block 19 on the frame causes them to dissociate and to drop the compacted waste mass in the trolley 18. It is then possible to treat another sack full of waste.

Figure 3 shows the press in position for the release of compacted wastes; according to a preferred method of the invention, the frame is equipped with a thrust block 19, which facilitates the release of compacted wastes and which, more importantly, ensures that the release of the waste is done without direct physical contact with the operator.

The device according to the invention can also be used for disinfecting medical material meant to be used again, such as metallic material such as scalpels, containers, etc.

The functioning of this device makes it possible to compact wastes while trapping contaminated particles and vesicles in the air caught in the wastes and released during compaction.

This step in the compacting offers the advantage of increasing the waste density up to a value close to its theoretic density to considerably improve the thermal conductivity of the wastes and to thus reduce the length of time required to bring all the wastes in a homogeneous way to a temperature sufficient for disinfection.

The use of conventional heating, notably thermal conduction from the heated press walls is thus made possible by the compacting of wastes which see their density and their thermal conductivity reach their optimal values.

But there is also another important advantage which is the possibility of treating waste indiscriminately, whether it is entirely metallic or totally without water or showing no dielectric losses, while processes using microwave energy sources or high frequency do not make this possible.

On the other hand, the whole of the press is thermally insulated so that all parts which could have been contaminated are brought to the same temperature and are

thus also disinfected during the treatment.

We can therefore see that the device provides disinfecting of waste with biological risks without contaminating superfluous material such as a grinder while self decontaminating during each operation.

Also, the process according to the invention avoids the release of foul-smelling odors. By compacting the waste sack 11 before heating and by treating it in a leak-proofed area, the degassing and so the odors, are considerably reduced.

I CLAIM:

1. A process for the thermal disinfection of waste, particularly that with biological risks and featuring a compaction chamber in which the waste is subjected to pressure, the gases given off by the compaction are filtered before being released, the chamber is then sealed and heat applied controlling simultaneously the temperature and the pressure inside the chamber, the temperature being maintained within a range of 100°C and 200°C, all parts having been in contact with the waste are also disinfected.

2. A process for the thermal disinfection of waste, particularly that with biological risks, according to Claim 1, characterized by the fact that the waste is covered beforehand with polymer, preferably composite, or placed in a polymer bag, preferably composite, before being brought into the compacting chamber.

3. A process for the thermal disinfection of waste, particularly that with biological risks, according to Claim 2, characterized by the fact that the sack is made of composite polymer with a polypropylene or polyamide exterior covering and a polyethylene interior lining.

4. A process for the thermal disinfection of waste, particularly that with biological risks, according to either one of Claims 1 to 3, and characterized by the fact that the heating temperature is higher than 134°C.

5. A process for the thermal disinfection of waste, particularly that with biological risks, according to either one of Claims 1 to 4, the said process also includes the decompression of the compaction chamber, the cooling of the chamber and its compacted waste to a temperature below 60°C, its return to atmospheric pressure and the removal of the waste.

6. A device for the thermal disinfection of waste, particularly that with biological risks which includes a riser collar 1, a jack 2 operated piston 3, a compaction chamber 4, a filter 6, a thermal block 17, a sack 11 filled with waste to be disinfected, means of heating, means of leak proofing the device and a thermal insulation.

7. A device for the thermal disinfection of waste, particularly that with biological risks in accordance to Claim 6, which also includes a pressure transducer and/or a strain gauge and/or an insulation gate 14 and/or an extractor 16 and/or an evacuation opening 15 coupled with a gate 12 with or without a frame.

8. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 or 7, featuring lugs 10 on the face of the jack 2 which is in contact with the waste.

9. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with

either one of Claims 6 to 8, featuring a hydraulically operated jack or a mechanically operated jack 3, driven by an electric motor.

10. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 9, whereby the heat is produced with electric heating elements and/or voltage-dependent resistors.

11. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 10, whereby leak proofing is provided by O-ring seals or by suitably fitted inflatable rings strategically placed and/or with insulation gates 12 and 14.

12. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with Claims 6 to 11, whereby the piston 2, the compaction chamber 4, the riser collar 1, are partially or entirely made of stainless metal of sufficient hardness to withstand scratching or deterioration by needles and scalpels during compacting.

13. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 12, whereby the piston 2, the compaction chamber 4, the riser collar 1, are partially or

entirely made of or covered with a metal of high thermal conductivity.

14. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 13, whereby the frame is equipped with a thrust block 19.

15. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 14, whereby the filter 6 is so located that it and the space separating it from the waste are at essentially the same temperature as that within the compaction chamber.

16. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 15, whereby the filter 6 is of very high efficiency such as a mineral membrane and/or activated carbon and/or teflon felt.

17. A device for the thermal disinfection of waste, particularly that with biological risks in accordance with either one of Claims 6 to 16, whereby the pressure transducer and/or the strain gauge is installed on the hydraulic system of the jack 3.

fig.1

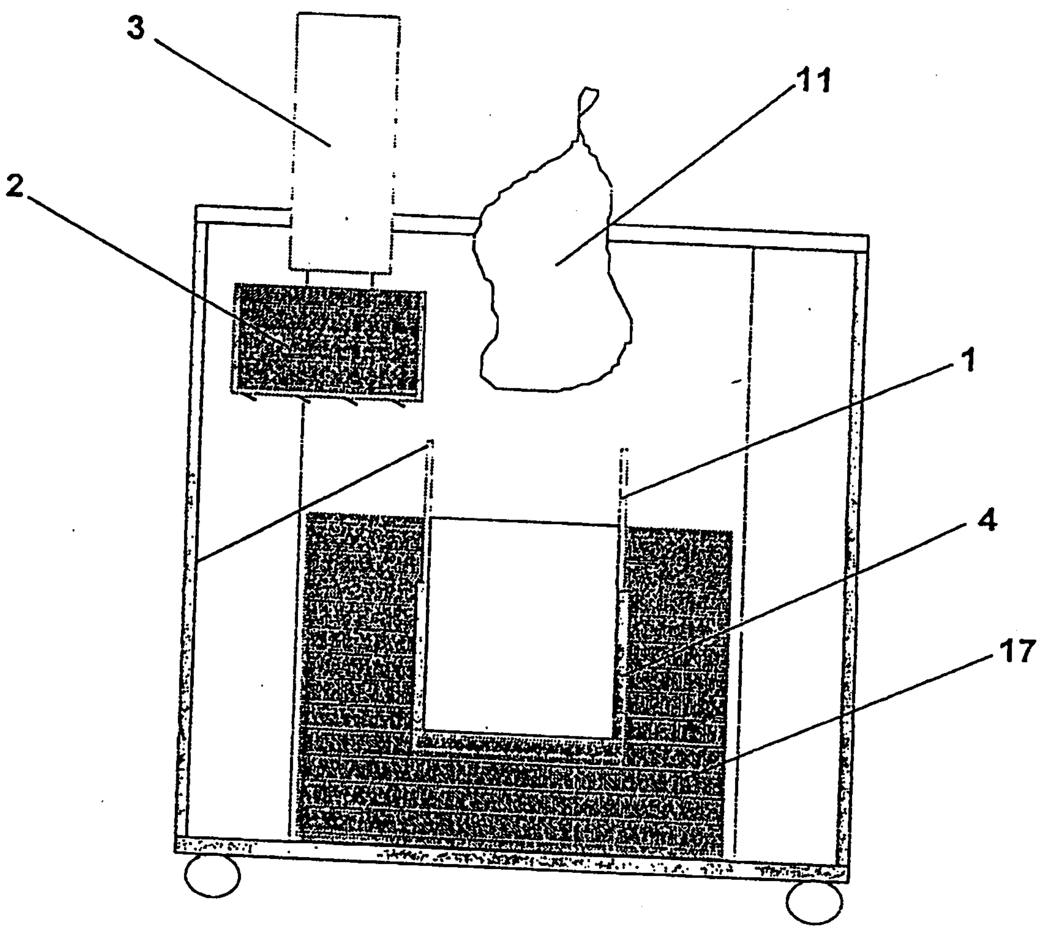


fig.2

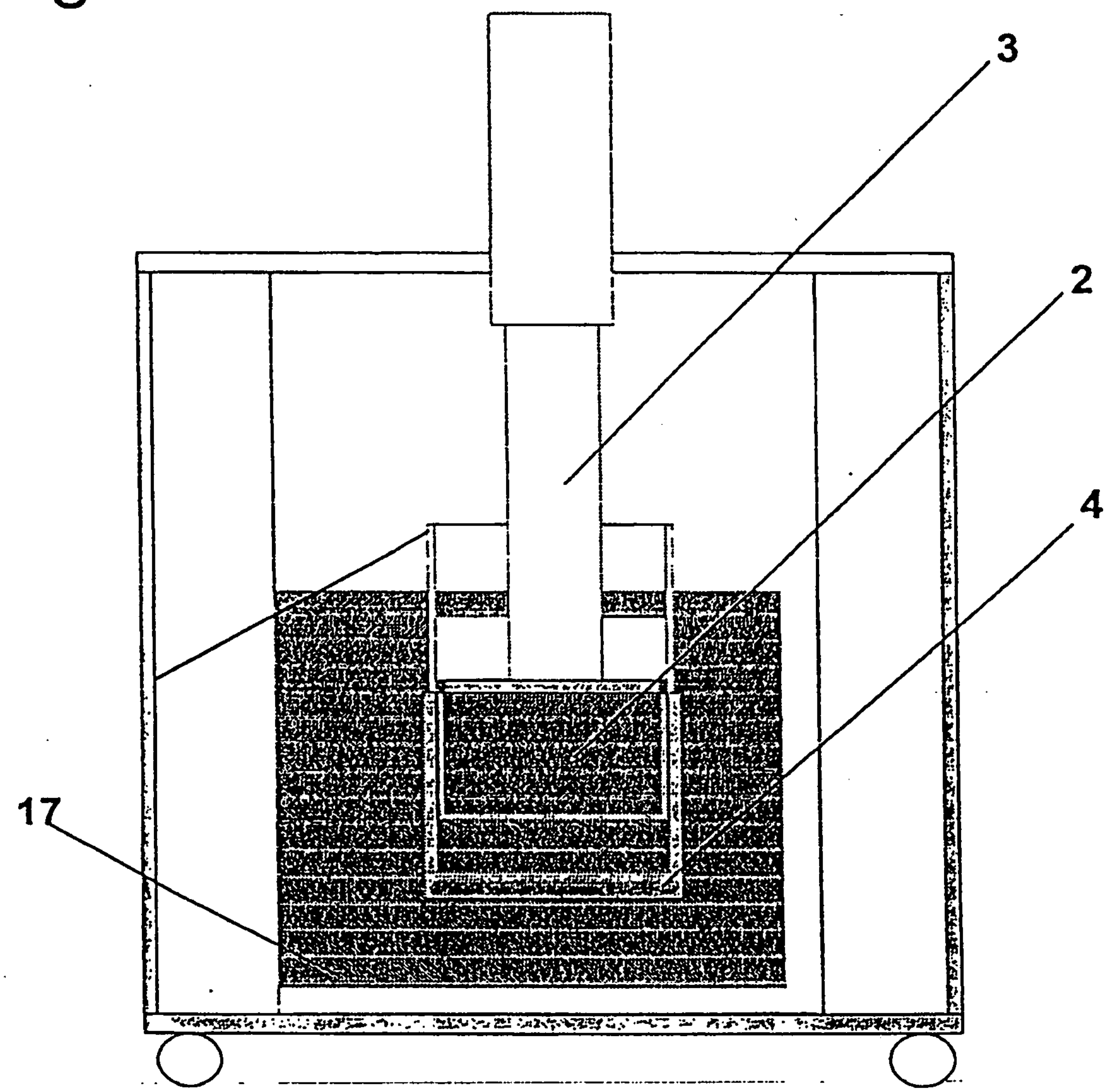


fig.3

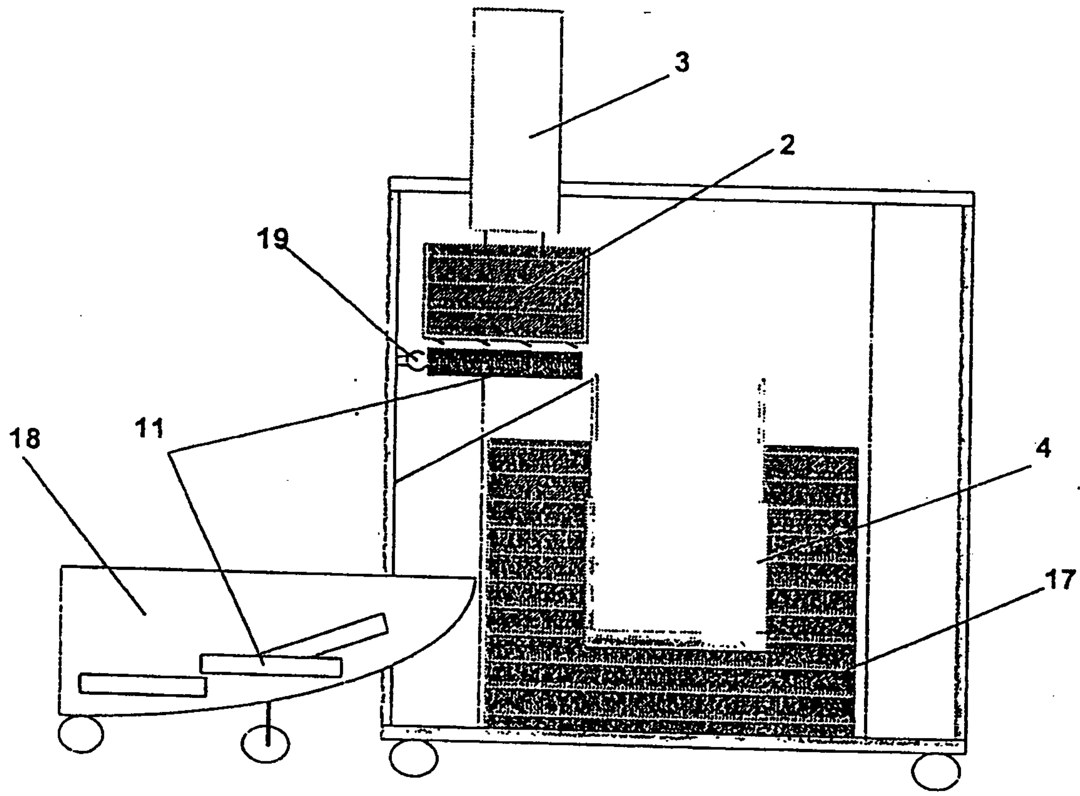


fig.4